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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D02G 3/40 — A1

(11) International Publication Number: WO 95/22644

(43) International Publication Date: 24 August 1995 (24.08.95)

(21) International Application Number: PCT/DK95/00073

(22) International Filing Date: 21 February 1995 (21.02.95)

(30) Priority Data:
210/94 21 February 1994 (21.02.94) DK

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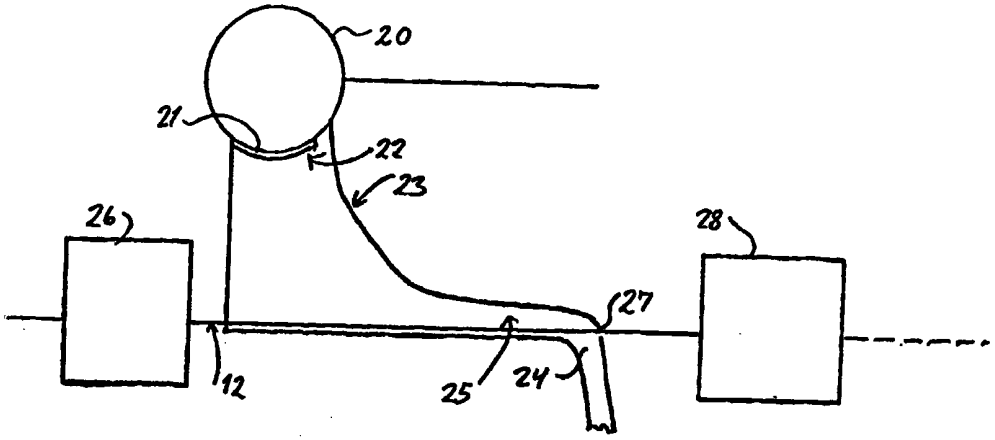
(81) Designated States: AM, AT, AT (Utility model), AU, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, SK (Utility model), TJ, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SYNTHETIC FIBERS IN COMBINATION WITH OTHER FIBERS



(57) Abstract

By manufacturing a fiber (1, 10) the major part of which consists of thermoplastic resin with a large number of short fibers (3, 13) applied to and fixed in a surface coating of thermoplastic resin on bicomponent fibers (2, 12) which form the "core" of the combination fiber (1, 10), a fiber is obtained that is particularly suited as full or partial binding material in a dry-formed fiber product. Owing to the projecting short fibers, good connection and fastening abilities are obtained in the fiber of the dry-formed product. Therefore, tensile strength is obtained in the dry-formed product without breaking the connection between the dry-formed fibers and the combination fibers. The binding is particularly strong and elastic when the combination fibers (1, 10) are creped.

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SYNTHETIC FIBERS IN COMBINATION WITH OTHER FIBERS

The present invention relates to a method for manufacturing fibers that are at least partially produced from synthetic fibers and wherein short fibers are applied and fixed on or between the surfaces of generally endless and at least partially synthetic fibers, the endless fibers being heated to the plasticization temperature of a surface coating of a thermoplastic resin, the short fibers being applied to the surface of the endless fibers, and the latter being cooled subsequently so that the short fibers become fixed in the surface coating of the endless fibers for formation of combination fibers.

When producing fiber products containing creped fibers (also referred to as curled fibers) or rectilinear fibers as full or partial binding material instead of latex, a product with good hand and feel is obtained. The use of synthetic fibers, e.g. bicomponent fibers, in a dry-formed product serves two main purposes. One purpose is to keep the fibers of the dry-formed product together so that a binding or a glue appears in the product in transverse direction (i.e. through the thickness of the product). Thus, it is assumed that the synthetic fibers are essentially located in the center of the dry-formed product. The second main purpose is for the synthetic fibers to prevent the dry-formed product from being stretched beyond approximately 10% which would mean a risk that the dry-formed product might burst. Thus, the synthetic fibers must have a stretching percentage that is smaller than the stretching percentage involving a risk that the dry-formed product may burst.

A dry-formed product has a stretching ability of up to approximately 10%. During stretching of the dry-formed product, rectilinear needle-shaped synthetic fibers or bicomponent fibers will often be displaced in the product and lose their capacity as a binding material between the dry-formed fibers of the product. This is inconvenient since the product is not prevented from stretching beyond the critical approximately 10%. Thereby there is a risk that the product may burst. The product may further give an unpleasant feel against the skin because the fibers may project from the product surface.

For these reasons it is preferred to use bicomponent fibers that have been made elastic by means of creping. However, such creped or curled fibers are very expensive compared to using latex as a binding material. It is also costly to use creped fibers since they are approximately twice as expensive as rectilinear bicomponent fibers.

Nevertheless, it is desirable to use bicomponent fibers as full or partial binding material in the dry-formed product. As bicomponent fibers may be cut into suitable lengths, e.g. between 6 and 12 mm, such bicomponent fibers may be mixed intimately with cellulose fibers. Such a mixture of fibers may be used in the manufacture of the fiber product by the so-called dry method. That is, a method in which air is used as a carrying medium for forming the fibers of the fiber product. The dry method is commonly known in the art and is disclosed in GB patent No. 2,800,638 and US patent No. 4,494,270, among others. Methods for the manufacture of combination fibers are known e.g. from DE publication No. 2,521,232 and DE *Offenlegungsschrift* No. 2,042,762. However, these documents merely disclose rectilinear combination fibers which would involve the same disadvantages as the known rectilinear bicomponent fibers.

Thus, by means of the known methods it is possible to manufacture the fiber product with high user comfort due to softness and a good hand and feel. However, it is desirable to improve the strength of such products as much as possible. Furthermore, it will be possible to reduce the amount of bicomponent fibers if they have an improved binding effect between the dry-formed fibers of the fiber product.

It is further desirable that a fiber manufactured by the method according to this invention is also suitable as a thready reinforcing element for the reinforcement of castable materials, e.g. concrete or building plates based on cement.

Thus, for the reinforcement of concrete various thready elements are known which have been given different dimensions and provided with undulations that are evenly distributed over the length of the reinforcement element. However, certain difficulties have been associated with the known thready reinforcement elements. Thus, it has

been necessary to use undulations with very large amplitudes and a very short undulation length, which has given rise to difficulties in their manufacture. The use of fibers or threads for the reinforcement of concrete in order to achieve improved ultimate strength is desirable. The increase of the tensile strength depends on the adhesion of the reinforcement element in the castable material.

It is the object of the present invention to disclose a method for manufacturing fibers to be used as full or partial binding material/reinforcement elements in dry-formed products and containing at least one surface coating of a thermoplastic resin, said fibers having improved ability to bind the individual fibers of a dry-formed product and said fibers also being usable as reinforcing elements in castable products.

According to the present invention this is achieved by a method which is characterized in that the endless fibers are led through a cloud of airborne short fibers being blown out from a defibrator, and in that during and/or after the application process the combination fibers are subjected to creping.

The short fibers may be fixed in the surfaces of the endless fibers by being moulded into or fused together with a surface coating and may be fixed between the surfaces of the endless fibers by being introduced between them while a number of endless fibers are being spun together.

By this method combination fibers are formed in which the short fibers are placed randomly and projecting from the central, generally endless fibers. The combination fiber will have the character of a bottlebrush or a spruce branch. Due to the projecting short fibers which are fixed in relation to the endless fibers, one obtains improved intimacy and cohesion with the fibers of a product that is manufactured with the combination fibers as a binding material/reinforcement. As the combination fibers are distributed in the center of the dry-formed product, the contents of this product will be held safely together. This is achieved by reducing or eliminating the risk that the combination fibers will be displaced inside the product and lose their connection with the dry-formed fibers.

Since the combination fiber has been subjected, e.g. during its passage through the calender, to creping in the manner explained in further detail below, the dry-formed product is prevented from bursting as a result of stretching. This is achieved in a simple manner by creping the combination fibers by a method making them unable to be stretched the approximately 10% which results in fractures in the dry-formed product. That is, the combination fibers are preferably creped so as to have a stretching percentage that is lower than the stretching percentage which the dry-formed product cannot tolerate without bursting.

The combination fibers will also contribute to a good cohesion of the product due to the "bushy" surface which causes the dry-formed cellulose fibers to become stuck. The fiber products manufactured by dry-forming are primarily sanitary products wherein there are strong requirements on softness. Such softness is also achieved due to the bushy exterior of the combination fibers.

According to the invention the short fibers are fixed in a surface coating of a thermoplastic resin on the endless fibers. The resin is plasticized by heating it to its plasticization temperature. The actual fixing of the short fibers in the coating may be ensured by leading the combination fibers through a calender wherein the short fibers are pressed into the plastic coating. If the last roller of the calender is cold and provided with a ribbed surface, creping of the combination fibers is achieved automatically. As has been explained above, this reduces the risk of fractures in the dry-formed product in which the creped combination fibers are used. At the same time the creped fibers will give the product improved hand and feel since the risk that fibers project from the fiber product is reduced.

Alternatively it is possible to manufacture the combination fibers with creping by knitting them together during simultaneous heating. On unravelling the knitted product after cooling, creped combination fibers will have formed which may be cut into the required lengths.

Another possibility of forming creped combination fibers is by twisting two or more

combination fibers together before or simultaneously with the application of the short fibers. When the product formed is untwisted after cooling, the combination fibers will appear with creping. Alternatively it is also possible to use combination fibers containing a "stem" of two or more twisted bicomponent fibers.

The production process preferably involves heating to between 80 and 120°C, and short fibers are applied having a length of between 2 and 5 mm. After cooling the combination fibers are cut into lengths of between 6 and 12 mm.

Although the combination fibers manufactured by this method are primarily intended for use in connection with dry-formed paper products wherein the combination fibers contain short cellulose fibers, it is also possible to use cotton fibers or other organic fibers. Likewise, it is possible to use mineral fibers, such as rock wool fibers, glass wool fibers or the like, as fixers in or between the surfaces of the endless fibers.

When using rock wool fibers, glass wool fibers or the like, the fibers according to the invention will be particularly suited for reinforcement of castable materials, e.g. concrete and building plates based on cement. In such materials the fibers/reinforcing elements will establish more strength and fastening than would be obtained with known rectilinear or undulating reinforcement fibers or elements. The use of fibers with reduced inflammability is desirable in building constructions.

The invention also relates to a dry-formed cellulose fiber product which is characterized in consisting of at least partially synthetic fibers with short fibers fixed in a surface coating of a thermoplastic resin, said combination fibers fully or partially constituting a binding material between the cellulose fibers of the cellulose fiber product.

When the combination fibers are manufactured with a stretching percentage, preferably of 8 to 9%, that is lower than the stretching percentage which a dry-formed product will tolerate according to experience (approximately 10%), a reinforcement fiber will be fully stretched to its maximum extension before the tensile limit of the dry-formed

product has been reached. In this manner the risk of fractures in the product is eliminated while at the same time the combination fibers will give the product a soft feel.

As mentioned previously, such a cellulose fiber product will be particularly suited for hygiene products wherein there are heavy requirements on softness and strength.

The invention will now be explained in further detail with reference to the attached drawings, wherein

Figure 1 shows two examples of combination fibers according to the invention; and

Figure 2 shows a schematic view of a plant for manufacturing a fiber according to the invention.

Figure 1 of the enclosed drawings shows two enlarged views of combination fibers. The combination fiber 1 is produced from a single partially synthetic fiber in the form of a generally endless bicomponent fiber 2 being provided with a relatively small number of cellulose fibers 3 which are fixed in the surface coating of the bicomponent fiber 2.

The combination fiber 10 is composed of several twisted or knitted generally endless bicomponent fibers 12 and a large number of short cellulose fibers 13. The combination fiber 10 will contain a large number of cellulose fibers because the latter will not only be fastened to the bicomponent fibers 12 by being fixed to the surface coating but will also be fastened by means of the twisting or spinning that has been applied to the bicomponent fibers.

Figure 2 shows a flow sheet of a plant for use by the method according to the invention. The plant consists of a defibrator 20 having an outlet opening 21 for defibrated material. The outlet opening 21 is located at the mouth 22 of a funnel 23. The funnel 23 has a tapered outlet opening 24. The airborne fibers pass through the funnel and obtain high concentration in an area 25 near the mouth 24 of the funnel 23. In this area a number of bicomponent fibers are spun together. The bicomponent fibers 12

have passed through a heating unit 26 before entering the funnel 23 and have been spun in the area 25 of the funnel 23. The spun bicomponent fibers 12 having been provided with short fibers leave the funnel through an opening 27 which is tightened so that loose short fibers will not follow out through that opening. The bicomponent fibers 12 are then led to a cutting unit 28. Immediately preceding the cutting unit one may optionally place a calender (not shown) the first roller pairs of which have been heated to the plasticization temperature and the last roller pair of which is cold and provided with ribbed surfaces for the formation of creped combination fibers.

It should be noticed that the use of a heating unit and a cutting unit is optional. Thus, it is possible to lead the fibers through the plant and merely perform spinning and then use these fibers as very long reinforcements. Such fibers may for example be usable for the reinforcement of castable products. If the formed bicomponent fibers are to be used as binding material/reinforcement elements for dry-formed products, it is preferred that they are cut into lengths having an extension of between 6 and 12 mm.

The plant shown in Figure 2 may also be used without performing any spinning in the area 25. In that case the endless synthetic fibers will pass through the heating unit 26 for plasticization of the surface so as to allow the short fibers to become fixed therein.

Application of the short fibers, which may be cellulose fibers or cotton fibers, is performed after the short fibers have left the defibrator 20 by bringing them into an air transportable condition and introducing them into the funnel 23 having a very large inlet mouth 22. The size of the inlet mouth depends on whether one single twisted fiber or a large number of e.g. 10 to 20 twisted or spun fibers 12 are produced at a time. In the tunnel the fibers are introduced in the broad end and travel by air transport towards the narrow outlet opening 24 in order to obtain an increase of the fiber concentration. Due to the heavy concentration of fibers in the area 25 at the small funnel-shaped outlet opening 24, the fibers will have such a density during a spinning process that they are necessarily entangled in the spinning process. If the endless fibers used are heated bicomponent ones having a thermoplastic surface, the short fibers will stick to the plasticized surface of the bicomponent fibers due to their density. The

endless fibers need not necessarily be bicomponent ones but merely synthetic fibers.

The plant shown in Figure 2 will preferably be a so-called compact unit known from US patent application Serial No. 08/141,936 filed on 28th October 1993 by the applicant of the present invention. The teachings of the US application are hereby incorporated by reference.

The two fibers 1, 10 are illustrated as examples of combination fibers which have been creped. It is possible, however, to manufacture the combination fibers rectilinear or with different degrees of creping adapted to the extensibility of the dry-formed products in which the combination fibers are to be used. Depending on the degree and type of creping required in the combination fibers, one may use different ones of the processes described above, or other processes which are known for the creping of bicomponent fibers.

CLAIMS

1. A method for manufacturing fibers that are at least partially produced from synthetic fibers and wherein short fibers are applied and fixed on or between the surfaces of generally endless and at least partially synthetic fibers, the endless fibers being heated to the plasticization temperature of a surface coating of thermoplastic resin, the short fibers being applied to the surface of the endless fibers, and the latter being cooled subsequently so that the short fibers become fixed in the surface coating of the endless fibers for formation of combination fibers, c h a r a c t e r i z e d in that the endless fibers are led through a cloud of airborne short fibers being blown out from a defibrator, and in that during and/or after the application process the combination fibers are subjected to creping.

2. A method according to claim 1, c h a r a c t e r i z e d in that the creping is performed after the application process by leading the combination fibers through a calender having rollers that are heated to the plasticization temperature.

3. A method according to claim 2, c h a r a c t e r i z e d in that at least one last pair of rollers in the calender is cold and is provided with ribbed surfaces in order to crepe the combination fibers.

4. A method according to claim 1, c h a r a c t e r i z e d in that the endless fibers are twisted or knitted together during or after the application process.

5. A method according to claims 1 and 4, c h a r a c t e r i z e d in that immediately after the twisting process and cooling to a temperature below the plasticization temperature of the surface coating, the combination fibers are untwisted.

6. A method according to any one of the preceding claims, c h a r a c t e r i z e d in that the short fibers are chosen among organic fibers, preferably cellulose and cotton fibers, or among mineral fibers, preferably rock wool and glass wool fibers.

7. A method according to any one of the preceding claims, c h a r a c t e r i z e d in that the temperature during application is between 80 and 120°C, that the short fibers used have a length of between 2 and 5 mm, and that the combination fibers are cut into lengths of 6 to 12 mm.

8. The use of combination fibers manufactured by a method according to any one of the preceding claims and having been cut into lengths of 6 to 12 mm as a full or partial binding material in a dry-formed cellulose fiber product.

9. A dry-formed cellulose fiber product c h a r a c t e r i z e d in containing creped combination fibers consisting of at least partially synthetic fibers with short fibers fixed in a surface coating of thermoplastic resin, said combination fibers fully or partially constituting a binding material between the cellulose fibers of the cellulose fiber product.

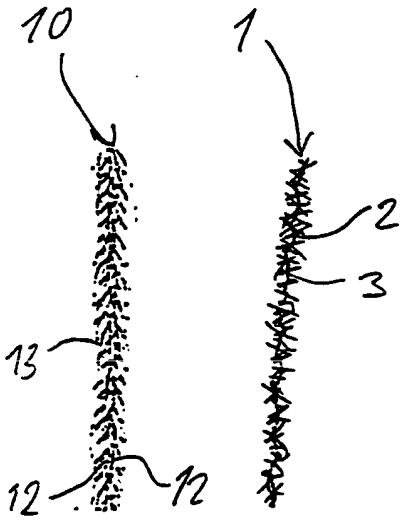

FIG. 1

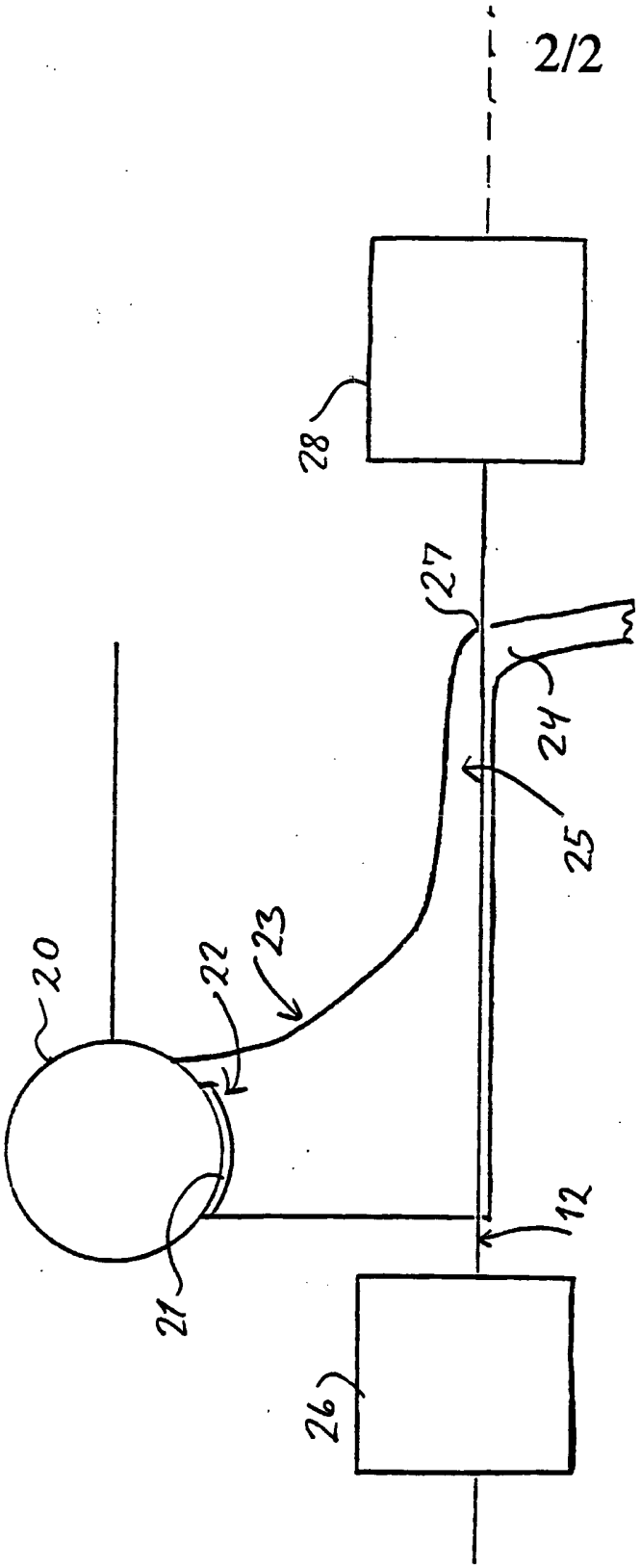

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 95/00073

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D02G 3/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D02G, D02J, D04H, D04D, D01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG, QUESTEL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4359856 (E. BOBKOWICZ), 23 November 1982 (23.11.82), column 1, line 58 - line 68; column 2, line 9 - line 14; column 3, line 66 - column 4, line 27, column 5, line 9 - line 19, figures 1,8	1,2,4,6
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 June 1995	19 -06- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Thorunn Grenmark Telephone No. +46 8 782 25 00

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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